

Deep-sea Gastropods from the New Zealand Region Associated with Recent Whale Bones and an Eocene Turtle

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ABSTRACT

Five species of gastropods are newly recorded from decaying whale bone from the deep-sea floor off New Zealand. *Paracocculina cervae* (Fleming, 1948), and new species of *Osteopelta*, Marshall, 1987 (Cocculiniformia), *Brucciella* Warén & Bouchet, 1993 (Vetigastropoda), and *Xylodiscula* Marshall, 1988 (Heterobranchia). Recently discovered material of *Osteopelta mirabilis* is recorded, and this or a closely similar species is recorded associated with turtle bones from the Middle Eocene of New Zealand. The new *Brucciella* and *Xylodiscula* species are the first records of skeneimorph gastropods from bone. Apart from whale bone, *Paracocculina cervae* is associated with sunken wood and algal holdfasts (new record), so it has the most generalised habitat of any known cocculiniform limpet.

Key words: Recent, fossil, Mollusca, Gastropoda, deep-sea, whale bone, turtle bone, New Zealand

INTRODUCTION

Since discovery of the limpet *Osteopelta mirabilis* Marshall, 1987, the first record of a gastropod living in association with decaying whale bones, a second species of *Osteopelta* has been recorded from bone off Iceland (Warén, 1989). More recently McLean (1992) has recorded a new species of *Cocculina* Dall, 1882 (Cocculinidae) and three species of *Pyropelta* McLean & Haszprunar, 1987 (Pyropeltidae) from whale bone from the eastern Pacific. One of these pyropeltid limpets was described as new, while the other two were evidently conspecific with specimens originally obtained from hydrothermal vents (McLean & Haszprunar, 1987). Dell (1987) has reviewed mytilid bivalves associated with whale remains. Additional taxa have been recorded by Smith et al. (1989), who drew attention to similarities between faunas associated with decaying whale bones, hydrothermal vents and hydrocarbon seeps, and suggested that whale skeletons may provide stepping stones for wide dispersal of deep-sea chemosynthetic communities (see also Smith, 1992).

In this paper I introduce a third species of *Osteopelta*, another cocculinid, and species of *Brucciella* Warén & Bouchet, 1993 and *Xylodiscula* Marshall, 1988 new to the fauna of this unusual habitat. *Brucciella* was based on a species from a hydrothermal vent, while previously known *Xylodiscula* species occurred in association with sunken wood, old sea grass (*Posidonia*) fibres, and a hydrothermal vent.

ABBREVIATIONS

- AMS Australian Museum, Sydney
 BMNH The Natural History Museum, London
 LACM Los Angeles County Museum of Natural History
 MNHN Museum National d'Histoire Naturelle, Paris
 MNZ Museum of New Zealand, Wellington
 NMP Natal Museum, Pietermaritzburg
 OU Geology Department, University of Otago, Dunedin
 USNM National Museum of Natural History, Washington, DC

Order ARCHAEOGASTROPODA Thiele, 1925
 Suborder COCCULINIFORMIA Haszprunar, 1987
 Superfamily COCCULINOIDEA Dall, 1882
 Family COCCULINIDAE Dall, 1882
 Genus *Paracocculina* Haszprunar, 1987

Paracocculina Haszprunar, 1987:321. Type species (by original designation): *Cocculina laevis* Thiele, 1903; Recent, off Nias Island, Sumatra.

Remarks: The genus *Paracocculina* was introduced by Haszprunar (1987) for species that differ from *Cocculina* Dall, 1882 primarily in having a prominent subpallial gland, a pedally innervated copulatory organ on the right side of the foot, and a hypothyroid nervous system with the osphradial ganglion situated at the far left side.



Figure 1. Map of New Zealand region showing localities for *Osteopelta praeceps* n. sp. and *O. mirabilis* (stars), *Bruceiella laevigata* n. sp. (solid circle), and *Bruceiella pruinosa* n. sp. (open circle). 200 and 1,000 meter contours indicated

Paraoeculina cervae (Fleming, 1948)

Cocculina cervae Fleming, 1948:88, text fig. 1a-d; Marshall, 1986:508, figs. 2A, 3A-C, 12AB

Tectierater cervae. Dell, 1956:60; Powell, 1979:81, fig. 10. 9.

Paraoeculina cervae. Haszprunar, 1987:321.

Material examined: (Additional to that recorded by Marshall, 1986): 39°53.2'S, 168°01.2'E, Challenger Plateau, New Zealand, alive on whale bone, 908–912 m, 3 July 1989, f.v. *Amaltal Explorer* (3 MNZ); 44°40.5'S, 174°01.0'E, off Banks Peninsula, alive on whale skull, 844 m, 11 May 1987, f.v. *Oyang 7* (5 MNZ); 38°38.9'S, 178°38.3'E, off Gable End Foreland, New Zealand, alive on algal holdfast, 529–565 m, 23 September 1985, f.v. *Wanaka* stn WK2 '68 '85 (1 MNZ); 43°02.5'S, 174°09.0'E, off Kaikoura, New Zealand, alive on algal holdfast, 848–877 m, 24 September 1988, f.v. *James Cook* stn J12/10, S5 (7 MNZ); 50°02.6'S, 169°31'E, east of the Auckland Is., New Zealand, alive on algal holdfast, 614–620 m, 4 December 1992, f.v. *Tangaroa* stn 92011/97 (many MNZ).

Distribution: North Cape to the Auckland Islands, New

Zealand, 18–891 m, on sunken wood, algal holdfasts and whale bone.

Remarks: Specimens from whale bone and deep-sunken algal holdfasts and wood proved to be indistinguishable in shell and radular morphology and in external anatomy.

Superfamily LEPETELLOIDEA Thiele, 1908

Family OSTEOPELTIDAE Marshall, 1987

Genus *Osteopelta* Marshall, 1987

Osteopelta Marshall, 1987:121. Type species (by original designation): *Osteopelta mirabilis* Marshall, 1987; Recent, New Zealand.

Osteopelta mirabilis Marshall, 1987

Osteopelta mirabilis Marshall, 1987:122, figs. 1A, B-D, F-J, 2A, 2B, 3C; Haszprunar, 1988:6, figs. 15–24 (anatomy).

Material examined: (Additional to that recorded by Marshall, 1987): 39°53.2'S, 168°01.2'E, Challenger Plateau, New Zealand, alive on whale bone, 908–912 m, 3 July 1989, f.v. *Amaltal Explorer* (18 MNZ); off Mernoo Bank, Chatham Rise, New Zealand, alive on large whale skull, ca. 900 m, October 1988, f.v. *Amaltal Explorer* (5 MNZ).

Distribution (figure 1): Challenger Plateau and Chatham Rise, New Zealand, on whale bone, 800–955 m.

Remarks: The Challenger Plateau specimens are indistinguishable from type and other material from the Chatham Rise. The protoconch is retained in a specimen 5.00 mm long, and is bilaterally symmetrical and 200 μ m long, with a long tapered apical fold tip on each side. Regrettably the sculpture is unknown, as the outer shell layer has been etched away. The Icelandic species *Osteopelta ceticola* Warén, 1989, also from whale bone, differs in minor details of radular morphology (Warén, 1989).

Osteopelta sp. cf. *mirabilis* Marshall, 1987

Material examined: Isolated concretion of Waihao Greensand on right bank of South Branch of Waihao River, north of Waihao Downs (map ref. J40 45000030), closely associated with bones of fossil leatherback turtle (*Dermochelys* sp.—Reptilia, Chelonia, Dermochelyidae), coll. R. E. Fordyce, A. Grebneff, C. M. Jones and P. A. Maxwell. Age: Bortonian (Middle Eocene) (1 specimen OU41112).

Remarks: The single specimen is embedded apex down in a block of gritty matrix with the fully exposed interior surface showing clearly defined muscle scars. A mould of the exterior where a small piece of the shell margin has broken away shows impressions of weak concentric sculpture. The specimen is indistinguishable from the Recent specimens of *Osteopelta mirabilis* in shape, shell thickness, teleoconch sculpture, muscle scar outline, and size (length est. 7.50 mm, width 6.05 mm). While it is

impossible to be absolutely certain of the relationships of this limpet from the teleoconch alone, particularly the interior, the association with bone suggests that it is probably an osteopeltid.

The Waihao Green sand beds were considered by Maxwell (1992) to have been deposited at 150–250 m depth, which is substantially shallower than the bathymetric range of living *O. mirabilis* (800–955 m).

***Osteopelta praeceps* n. sp.**
(figures 2–6, 18, 19)

Description: Shell up to 6.25 mm long, translucent white, thin and brittle, highly arched, anterior end occupying 48.8–62.5% of shell length in specimens over 4 mm in length. Aperture elliptical, anterior end more narrowly rounded than posterior; apertural plane shallowly concave at ends, weakly convex at sides; broadest slightly behind midlength. Apex tightly rounded, anterior slope flat or weakly concave, posterior slope broadly convex, lateral slopes weakly convex. Periostracum transparent, very thin, smooth.

Protoconch 200 μ m long, bilaterally symmetrical, apical fold producing a small, shallow dimple on each side, sculptured throughout with densely crowded minute punctations arranged in spiral lines.

Teleoconch sculptured with fine collabral growth lines, obscure radial lines, and many minute, randomly distributed, shallow pits.

Animal white. Foot broad and thick. Mantle edge thickened, with weak left anterolateral fold. Snout very large, tapered, longer than broad, deeply concentrically wrinkled, mouth a vertical slit in small, circular, flattened tip. No oral lappets. Cephalic tentacles slender, tapered, tips rounded, minute black eyes sunken in swellings at outer bases. A large secondary gill extending along right mantle groove to above right of head, comprising about 30 anteriorly enlarging leaflets. Seminal groove not detected. Two slender blunt-tipped, dorsoventrally flattened epipodial tentacles at posterior end.

Radula (figures 18, 19) with the formula $\infty + 6 + 1 + 6 + \infty$, indistinguishable from that of *O. mirabilis*.

Type data: Holotype MNZ M 116970 (length 5.50 mm, width 4.20 mm, height 3.40 mm) and 57 paratypes (51 MNZ, others AMS, BMNH, LACM, MNHN, NMP, USNM): 43°34.14'S, 176°18.69'E, E of Mernoo Bank, Chatham Rise, New Zealand, 372–379 m, 29 January 1992, f.r.v. *Tangaroa* stn 9106/168, alive on whale vertebra among crowded individuals of a species of *Idas* Jeffreys, 1876 (Mytilidae).

Other material examined: (Several hundred specimens MNZ): Topotypes (several hundred juveniles, MNZ M.117279); 39°53.2'S, 168°01.2'E, Challenger Plateau, New Zealand, 908–912 m, 3 July 1989, f.v. *Amaltal Explorer* stn 348/129, alive on a piece of whale bone among crowded mytilids (*Idas* sp.) (8 subadult specimens, MNZ M.92453).

Distribution (figure 1): Chatham Rise and Challenger Plateau, New Zealand, on whale bone, 372–912 m.

Remarks: *Osteopelta praeceps* differs from *O. mirabilis* in attaining smaller size and in having a narrower, taller shell with a longer anterior end. Their external anatomies and radulae are extremely similar. *O. praeceps* and *O. mirabilis* occurred living together on the same piece of whale bone from the Challenger Plateau (M.92453 and M.92451, respectively).

Immature specimens of *O. praeceps* are strikingly similar to young of the cocculinid *Paracocculina cervae* that also occurred on the Challenger Plateau bone. *P. cervae*, however, is distinguishable by its larger adult size, lack of shell micropunctations, in having a prominent copulatory organ behind the right cephalic lappet, and in having a snout that is short and broad instead of proboscis-like. Moreover, their radulae and anatomies are entirely different.

The highly arched shell and narrow aperture of *O. praeceps* enable it to live deeply (and inconspicuously) among the associated mytilids, which form densely crowded aggregations at nutrient-rich sites on the bones. By contrast, the larger and broader-shelled species *O. mirabilis* has been observed adjacent to mytilid aggregates (Marshall 1987: fig. 1A), and is probably unable to live as deeply among them.

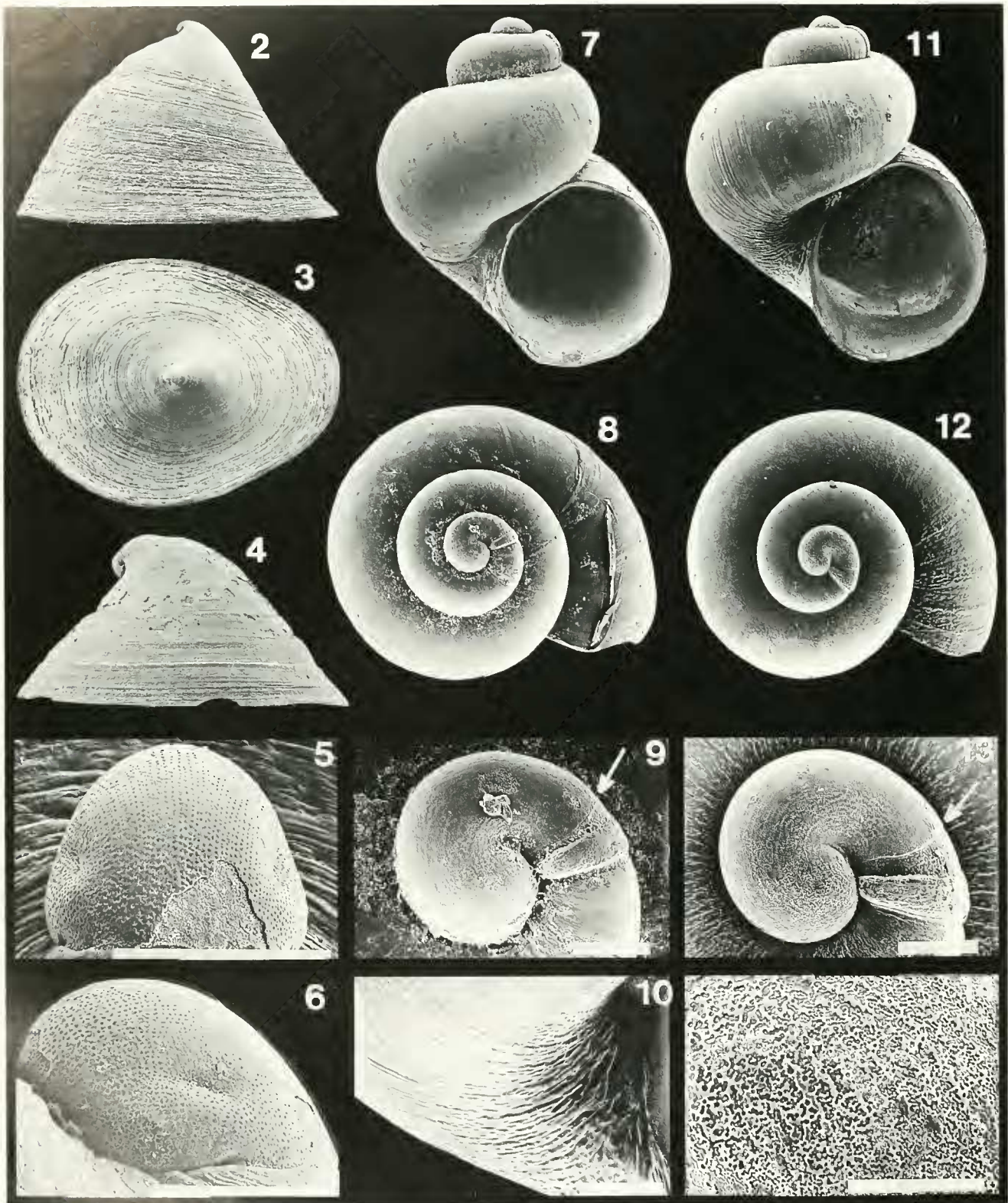
Etymology: Latin *praeceps* (steep).

Suborder VETIGASTROPODA Salvini-Plawen, 1980
Superfamily TROCHOIDEA Rafinesque, 1815
?Family SKENEIDAE Clark, 1851
Genus *Bruceiella* Warén & Bouchet, 1993

Bruceiella Warén & Bouchet, 1993:26. Type species (by original designation): *Bruceiella globulus* Warén & Bouchet, 1993; Recent, North Fiji Basin (hydrothermal vent).

Remarks: In having epipodial tentacles and papillate cephalic tentacles, the animal of *Bruceiella* bears a general resemblance to those of members of the family Skeneidae, the limits of which have been tightly restricted by Warén (1992) and Warén and Bouchet (1993). The lack of a propodial penis and the distally expanded snout, however, led Warén and Bouchet (1993) to suggest that the genus probably does not belong in Skeneidae, but by implication perhaps in a family of its own. The radula bears a striking resemblance to those of a variety of archaeogastropods associated with hydrothermal vents and seeps, especially neomphalids and peltospirids, a similarity that Warén and Bouchet (1993) consider to be the result of convergence.

The otherwise simple shell of *Bruceiella* species is distinctive in having a protoconch sculpture of minute dendritic threads and granules arranged in fine spiral lines, and a pronounced varix almost immediately after the protoconch-teleoconch boundary. Unlike Warén and Bouchet (1993), who interpret the varix as the termination of the protoconch, I consider that the varix is on the teleoconch, and that the actual protoconch-teleo-



Figures 2–14. Shells of *Ostcopelta* and *Brucciella* spp. 2–6. *Ostcopelta praeceps* n. sp. 2, 3. Holotype, length 5.50 mm. 4. Immature specimen, Challenger Plateau, MNZ M.92453, length 2.20 mm. 5, 6. Protoconch of holotype. 7–9. *Brucciella lacvigata* n. sp., holotype, height 1.70 mm. 9. Protoconch, with protoconch/teleoconch boundary arrowed. 10–14. *Brucciella pruinosa* n. sp., holotype, height 1.43 mm. 10. Detail of inner part of base. 13. Protoconch, with protoconch/teleoconch boundary arrowed. 11. Detail of protoconch sculpture. Scale bar 14 = 10 μ m, others = 100 μ m.



Figures 15–17. Shell of holotype of *Xylodiscula osteophila* n. sp., width 1.60 mm. 17. Protoconch, note inrolled tip. Scale bar = 100 μ m.

conch boundary is a sharply defined line at a distance behind the varix equivalent to about one varix thickness (figures 9, 13). I also disagree with Warén and Bouchet (1993) that the varix in their genus *Ventsia* is part of the protoconch and instead consider that it is situated at the end of the first quarter teleoconch whorl. Species of the related genus *Xyloskenca* Marshall, 1988 exhibit a change in teleoconch sculpture following a sharply defined growth scar at an equivalent position (Marshall, 1988, figs: 4EJ, 5E; Warén & Bouchet, 1993: fig. 23A). The zone between the varix and the protoconch/teleoconch boundary is analogous to protoconch II of higher gastropods, though not homologous because protoconch enlargement through marginal incrementation is unknown in archaeogastropods other than Neritimorpha. These growth disturbances probably represent a period of crisis, perhaps a change in feeding mode during the earliest stages of postsettlement development.

***Bruceiella laevigata* n. sp.**
(figures 7–9, 20–22)

Description: Shell up to 1.70 mm high, slightly higher than broad, thin, translucent, glossy, with narrow umbilical chink, periostracum smooth.

Protoconch 300 μ m wide, delineated by fine groove, apical fold tip broadly rounded, sculptured with minute anastomosing dendritic threads arranged in fine spiral lines.

Teleoconch of up to 2.20 strongly and rather evenly convex whorls. First sixteenth whorl minutely granulate; next sixteenth whorl occupied by strong, rounded varix, immediately followed by fine groove; elsewhere smooth. Aperture subcircular, lips thin, parietal contact area narrow.

Animal. Snout subquadrate; cephalic tentacles dorsoventrally flattened, tapered, similar, edges ciliated; foot large, anteriorly indented. Small right and large left sub-optic tentacle, 3 small right epipodial tentacles beside operculum, 1 large left epipodial tentacle, 2 small left epipodial tentacles beside operculum. No eyes.

Radula (figures 20–22) with the formula $\infty + 5 + 1$

+ 5 + ∞ , teeth longer than broad. Central tooth stout; cutting area narrowly angulate, without secondary cusps, prominently hooded; shaft face subtriangular, suddenly narrowed at base. Lateral teeth stout, enlarging outwards, cutting areas large, hooded, roundly angulate, coarsely serrate, terminal cusp largest; shafts outwardly bowed, strongly flanged and convoluted to interlock with adjacent teeth. Marginal teeth slender, outwardly narrowing and with smaller cutting areas and finer cusps, outermost few pairs with spatulate tips and fused shafts.

Type data: Holotype (height 1.70 mm, diameter 1.50 mm, 2.20 teleoconch whorls) MNZ M.116969; paratypes (5 MNZ, 1 AMS, 1 MNHN): 43°00.17'S, 174°05.5'W, NE of Chatham Islands, New Zealand, 1,242 m, 23 August 1989, f.v. *Otago Buccaneer* tow 31; alive amongst crowded mytilids (*Idas* sp.) on a whale skull.

Distribution (figure 1): Northeast of Chatham Islands, New Zealand, on whale bone, 1,242 m.

Remarks: Compared with the type species, *Bruceiella laevigata* is more tightly coiled with a higher spire, but otherwise the two species are similar. Among the host of superficially similar skeneimorph gastropods known from the New Zealand region (MNZ—many undescribed), *B. laevigata* is characterised by the combination of distinctive protoconch sculpture, the strong postlarval varix, and the radular morphology.

Etymology: Latin *laevigatus* (smooth), alluding to the lack of shell sculpture after the postlarval varix.

***Bruceiella pruinosa* n. sp.**
(figures 10–14, 23)

Description: Shell (holotype) 1.43 mm high, slightly higher than broad, thin, translucent, glossy, with narrow umbilical chink, periostracum smooth.

Protoconch 280 μ m wide, delineated by fine groove, apical fold tip broadly rounded, sculptured with minute anastomosing dendritic threads arranged in fine-spiral lines.

Teleoconch of 2.10 strongly and rather evenly convex



whorls. First sixteenth whorl minutely granulate; next sixteenth whorl occupied by strong, rounded varix, immediately followed by fine groove. Apical quarter of spire whorls, and inner half of base with minute granules and very fine axial wrinkles, stronger on base. Aperture subcircular, lips thin, parietal contact area narrow.

Animal. Similar to that of *B. laevigata* but with 1 large right and 2 large left epipodial tentacles, instead of 4 right and 3 left epipodial tentacles.

Radula (figure 23) as in *B. laevigata*.

Type data: Holotype MNZ M.116968 (height 1.43 mm, diameter 1.33 mm, 2.10 teleoconch whorls): 39°53.2'S, 168°01.2'E, Challenger Plateau, New Zealand, 908–912 m, 3 July 1989, f.v. *Amaltal Explorer* stn 348/129; alive amongst crowded mytilids (*Idas* sp.) on a piece of whale bone.

Distribution (figure 1): Challenger Plateau, New Zealand, on whale bone, 908–912 m.

Remarks: *Brucciella pruinosa* differs from both *B. globulus* and *B. laevigata* in having a teleoconch sculpture of minute granules and fine axial wrinkles.

Etymology: Latin *pruinosa* (frosty), alluding to the finely granulate surface.

Subclass HETEROBRANCHIA Gray, 1840

Order HETEROSTROPHA Fischer, 1855

Family XYLODISCULIDAE Warén, 1992

Genus *Xylodiscula* Marshall, 1988

Xylodiscula Marshall, 1988:955. Type species (by original designation): *Xylodiscula vitrea* Marshall, 1988, Recent, New South Wales.

Remarks: *Xylodiscula* was originally referred to Orbitestellidae for want of a more appropriate position (Marshall, 1988). Subsequent reevaluation of Orbitestellidae by Ponder (1990), however, suggested that this placement is untenable, and Warén (1992) has segregated *Xylodiscula* in a family of its own.

The new species described below is the first record of a xylodisculid from whale bone. Other *Xylodiscula* species live at 90–1,100 m in association with sunken wood (Marshall, 1988; Warén, 1992) and old sea grass (*Posidonia*) fibres (Warén, 1992). Most recently a *Xylodiscula* species has been recorded from a hydrothermal vent at 2,000 m depth in the North Fiji Basin (Warén & Bouchet, 1993).

***Xylodiscula osteophila* n. sp.**
(figures 15–17, 24, 25)

Description: Shell (holotype) 1.60 mm wide, markedly wider than high, spire weakly elevated, thin, translucent, colorless, umbilicate, periostracum smooth.

Protoconch 270 μ m wide, 1.75 whorls; tip infolded, very small, finely granulate; last whorl smooth.

Teleoconch of 2.25 convex whorls, suture shallowly channelled. First 1.25 whorls evenly convex; last whorl with weakly convex side, and strongly rounded periphery. Base convex, evenly rounded into umbilicus, obscure spiral lines throughout. Collabral growth lines gently prosocline on spire, weakly sigmoidal on base. Umbilical diameter 17% of shell diameter. Aperture subcircular. Outer lip thin; inner lip thickened and angled against umbilical rim, thin apically. Parietal area broad, inductura extremely thin.

Animal unknown (dried). Operculum thin, translucent, chitinous multispiral.

Radula (figures 24, 25) with the formula 2 + 1 + 0 + 1 + 2, extremely small. Lateral teeth small, thin, subquadrate, cutting area almost straight and finely serrate. Marginal teeth similar, large, stout, slender, curved, very long finely serrate cutting area on both edges.

Type data: Holotype (height 1.07 mm, width 1.60 mm, 2.25 teleoconch whorls) MNZ M.116971 off Mernoo Bank, Chatham Rise, New Zealand, ca. 900 m, October 1988, f.v. *Amaltal Explorer*; alive on large whale skull amongst crowded mytilids (*Idas* sp.).

Distribution (figure 1): Off Mernoo Bank, Chatham Rise, New Zealand, on whale bone, ca. 900 m.

Remarks: *Xylodiscula osteophila* differs from other named *Xylodiscula* species in the greater shell height relative to width, the thickened and angled inner lip, and the considerably narrower umbilicus.

Etymology: From the Greek *osteon* (bone) and *philos* (loving).

ACKNOWLEDGEMENTS

I am grateful to the numerous fisheries scientists and observers (MAF Fisheries, Wellington) who obtained the samples of whale bone, to A. Grebneff (University of Otago) who drew my attention to the fossil osteopeltid, and to J. H. McLean (Los Angeles County Museum of Natural History) for constructive comments on the manuscript. Thanks also to W. St George (Institute of Geological and Nuclear Sciences, Lower Hutt) for access to the scanning electron microscope, D. Wilkinson for word processing, and to T. Meek for photographic printing.

Figures 18–25. Radulae ex holotypes. 18, 19. *Ostropelta praeceps* n. sp., full width (18) and detail of central and lateral teeth (19). 20–22. *Brucciella laevigata* n. sp., full width (20), central and lateral teeth (21) and marginal teeth (22). 23. *Brucciella pruinosa* n. sp., central (left), lateral and inner marginal teeth. 24, 25. *Xylodiscula osteophila* n. sp., marginal teeth and the small central tooth (left center in 24). Scale bars = 10 μ m.

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